

# National Advisory Committee for Aeronautics

## Research Abstracts

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### CURRENT NACA REPORTS

NACA Rept. 1085

DISCUSSION OF BOUNDARY-LAYER CHARACTERISTICS NEAR THE WALL OF AN AXIAL-FLOW COMPRESSOR. Artur Mager, John J. Mahoney and Ray E. Budinger. 1952. ii, 20p. diagrs., photo., tab. (NACA Rept. 1085. Formerly RM E51H07)

Boundary-layer velocity profiles on the casing of an axial-flow compressor behind the guide vanes and rotor were measured and resolved into two components: along the streamline of the flow and perpendicular to it. Boundary-layer thickness and the deflection of the boundary layer at the wall were the generalizing parameters. By use of these results and the momentum-integral equations, the characteristics of boundary layer on the walls of axial-flow compressor are qualitatively discussed. Important parameters concerning secondary flow in the boundary layer appear to be turning of the flow and the product of boundary-layer thickness and streamline curvature outside the boundary layer. Two types of separation are shown to be possible in three dimensional boundary layer.

NACA Rept. 1088

THEORETICAL DAMPING IN ROLL AND ROLLING MOMENT DUE TO DIFFERENTIAL WING INCIDENCE FOR SLENDER CRUCIFORM WINGS AND WING-BODY COMBINATIONS. Gaynor J. Adams and Duane W. Dugan. 1952. ii, 11p. diagrs. (NACA Rept. 1088. Extends analysis of TN 2270)

A method of analysis based on slender-wing theory is developed to investigate the characteristics in roll of slender cruciform wings and wing-body combinations. The method makes use of the conformal mapping processes of classical hydrodynamics which transform the region outside a circle and the region outside an arbitrary arrangement of line segments intersecting at the origin. The method of analysis may be utilized to solve other slender cruciform wing-body problems involving arbitrarily assigned boundary conditions.

NACA TN 2923

STUDY OF MOTION OF MODEL OF PERSONAL-OWNER OR LIAISON AIRPLANE THROUGH THE STALL AND INTO THE INCIPIENT SPIN BY MEANS OF A FREE-FLIGHT TESTING TECHNIQUE. Ralph W. Stone, Jr., William G. Garner and Lawrence J. Gale. April 1953. 28p. diagrs., photos., tab. (NACA TN 2923)

This paper presents the motion of a dynamic model through the stall and into the incipient spin. The results indicate that, after the initial stall, the model became unstalled, inverted, and assumed very low angles of attack before restalling and entering the incipient spin. Altitude loss and angular velocities were relatively small during the early part of the motion and indicated that this time would be the optimum time to terminate the motion by control movement.

NACA TN 2925

LIFT DEVELOPED ON UNRESTRAINED RECTANGULAR WINGS ENTERING GUSTS AT SUBSONIC AND SUPERSONIC SPEEDS. Harvard Lomax. April 1953. 44p. diagrs., 2 tabs. (NACA TN 2925)

Lift forces induced by a vertical gust are estimated on the basis of theoretical calculations. The effects of pitching and wing bending are neglected and only wings of rectangular plan form are considered. However, the effects of Mach number (from 0 to 2) and aspect ratio (2 to  $\infty$ ) are included, and solutions are given by means of which the response to gusts having arbitrary streamwise gradients can be calculated. Results are presented for sharp-edged and triangular gusts and various wing-air density ratios.

NACA TN 2931

A METHOD FOR DETERMINING CLOUD-DROPLET IMPINGEMENT ON SWEEPED WINGS. Robert G. Dorsch and Rinaldo J. Brun. April 1953. 29p. diagrs. (NACA TN 2931)

The general effect of wing sweep on cloud-droplet trajectories about swept wings of high aspect ratio moving at subsonic speeds is discussed. A method of computing droplet trajectories about yawed cylinders and swept wings is presented, and illustrative droplet trajectories are computed. A method of extending two-dimensional calculations of droplet impingement on nonswept wings to swept wings is presented. It is shown that the extent of impinge-

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ment of cloud droplets on an airfoil surface, the total rate of collection of water, and the local rate of impingement per unit area of airfoil surface can be found for a swept wing from two-dimensional data for a nonswept wing. The impingement on a swept wing is obtained from impingement data for a nonswept airfoil section which is the same as the section in the normal plane of the swept wing by calculating all dimensionless parameters with respect to flow conditions in the normal plane of the swept wing.

NACA RM E52L23a

FREE FALL AND EVAPORATION OF *n*-OCTANE DROPLETS IN THE ATMOSPHERE AS APPLIED TO THE JETTISONING OF AVIATION GASOLINE AT ALTITUDE. Herman H. Lowell. April 1953. 25p. diags. (NACA RM E52L23a)

In connection with proposed rapid jettisoning of aviation gasoline at altitude, a theoretical study was made of the free fall and evaporation of *n*-octane droplets in the atmosphere; *n*-octane was selected for study because of the expected similarity of overall evaporation behavior of *n*-octane and gasoline. It was concluded that gasoline (or *n*-octane) droplets larger than 2000 microns in diameter would be unstable; terminal speeds and Reynolds numbers were obtained for droplets not larger than 2000 microns at altitudes to 11,000 feet. The motion data were used in the calculation of *n*-octane evaporation rates under various conditions. It was found that a droplet having an original diameter of 2000 microns would fall about 4000 feet from 6000 feet under NACA standard atmosphere conditions before coming virtually to rest. Finally, it was concluded that temperature effects are of paramount importance; at highest air temperatures a 1000-foot ground clearance would probably be adequate to prevent ground contamination, whereas at lowest air temperatures only an atomizing spray arrangement would prevent ground contamination, irrespective of ground clearance.

## BRITISH REPORTS

N-21216\*

Aeronautical Research Council (Gt. Brit.)  
ABSTRACTS OF PAPERS PUBLISHED EXTERNALLY. February 1951. 15p. (ARC R & M 2722)

This report contains abstracts of a group of reports recommended for external publication by the Aeronautical Research Council. These reports cover a variety of subjects relating to aeronautics.

N-21712\*

Royal Aircraft Establishment (Gt. Brit.)  
INTERNAL FRICTION AND GRAIN BOUNDARY VISCOSITY OF SILVER AND OF BINARY SILVER SOLID SOLUTIONS. S. Pearson. January 1953. 22p. diags., 4 tabs. (RAE Met. 71)

Measurements have been made of the variation of internal friction with temperature for spectroscopically pure silver and for a series of solid solutions of silver with cadmium, indium, and tin, using a Kê type torsion pendulum apparatus. Some experiments have also been made to investigate the effect of nonmetallic impurity on grain boundary relaxation in silver. The effect of the alloying elements is to increase the grain boundary viscosity and to raise the activation energy for grain boundary relaxation from 22,000 cal/mole for pure silver to 43,000 cal/mole for the solid solutions, the same value being obtained, within the limits of experimental error, for all the alloying elements and for all the solute concentrations investigated. The results of the experiments show exactly the same trend as those obtained previously for a similar series of copper solid solutions. They are in agreement with the general theory of grain boundary relaxation developed by Zener and Kê but do not seem to be in agreement with either of the mechanisms so far put forward to explain grain boundary slip.

N-21717\*

Royal Aircraft Establishment (Gt. Brit.)  
CURVES FOR ESTIMATING THE WAVE DRAG OF SOME BODIES OF REVOLUTION, BASED ON EXACT AND APPROXIMATE THEORIES. L. E. Fraenkel. August 1952. 15p. diags. (RAE Tech. Note Aero 2184)

Curves are presented for estimating the wave drag, at zero incidence, of forebodies and afterbodies having straight and parabolic profiles. The afterbodies are assumed to lie behind an infinitely long cylindrical body. The curves are based on a limited number of exact and second-order solutions which have been generalized by appealing to the supersonic-hypersonic similarity law and to slender body and quasi-cylinder solutions.

N-21719\*

Royal Aircraft Establishment (Gt. Brit.)  
ON THE GEOMETRICAL CHANGES THAT OCCUR WHEN WINGS ARE ROTATED ABOUT AXES THAT ARE NEARLY NORMAL TO THE WINGS. C. H. E. Warren. November 1952. 10p. diags. (RAE Tech. Note Aero 2212)

This note merely presents the geometrical relationships that occur when the wings of an aircraft are rotated about axes that are nearly normal to the planes of the wings. Only elementary, but somewhat cumbersome, trigonometry is involved, but the relationships do depend upon precise definitions of the angles of sweepback and dihedral.

N-21743\*

Aeronautical Research Council (Gt. Brit.)  
NOTE ON THE WAKES BEHIND BODIES MOVING  
AT HIGH MACH NUMBER. D. W. Holder.  
March 8, 1952. 11p. photos., diagrs., tab. (ARC  
14, 720; FM 1693)

Schlieren photographs are presented to provide ex-  
amples of apparently periodic, or otherwise unusual,  
flow in the wakes of bodies moving at high Mach  
number.

## UNPUBLISHED PAPERS

N-22547 \*

FUSELAGE SHOCK ABSORBERS. (Amortizatory  
shassi). 13p. diagrs. (Trans. from Construction  
of Airplanes, by M. N. Shulzhenko, 1949, p. 403-  
410).

This report describes the principles of operation  
and construction of liquid-air shock absorbers.

N-22618 \*

THE HYDRODYNAMIC THEORY OF HEAT  
EXCHANGE AND ITS APPLICATION TO THE  
EXTERNAL PROBLEM OF THE BOUNDARY  
LAYER. (O svyazi obobshchennykh integral'nykh  
sootnoshenii s gidrodinamicheskoi teoriei teploob-  
mena i o ee prilozhenii k raschetu teploobmena v  
usloviyakh vneshnei zadachi). L. I. Kudryashev.  
11p. (Trans. from Akademiia Nauk SSSR, Izvestiia,  
Otdelenie Tekhnicheskikh Nauk, no. 11, 1951, p.1682-  
1688).

A connection is established between the generalized  
integral relations for the hydrodynamic and thermal  
boundary layers, both laminar and turbulent, and  
the hydrodynamic theory of heat exchange. The  
application to the computation of the heat exchange  
permits solving the problem of the computation of  
the heat-transfer coefficient in the case of the flow  
about a flat plate for any law of distribution of the  
velocities and temperatures in the boundary layer.

N-22619\*

THE OXIDIZING NITRATION OF NITROSO COM-  
POUNDS AND ARYLHYDROXYLAMINES.  
(Okislitel'noe nitrovanie aromaticeskikh nitrozo-  
soedinenii i arilgidroksilaminov). A. I. Titov and  
N. G. Laptev. EXPERIMENTAL PROCEDURE, by  
A. I. Titov, N. G. Laptev and A. N. Baryshnikova.  
11p. (Trans. from Zhurnal Obshchei Khimii, v. 18,  
pt. 1, 1948, p. 741-748).

It is shown that the aromatic nitroso compounds and  
arylhydroxylamines under the action of nitric acid  
containing nitrogen oxides may undergo very differ-  
ent transformations leading to the formation of a

mixture of the corresponding nitro compounds, diazo  
compounds, p-dinitroso compounds, p-nitrosodiaryl-  
hydroxylamines, oxalic acid, and nitrophenols con-  
taining hydroxyl in the para position relative to the  
place previously occupied by the nitroso group.  
Mechanisms for these reactions are proposed.  
Detailed procedure is given for performing the  
nitration.

N-22620\*

ON THE MECHANISM OF THE NITRATION OF  
AROMATIC COMPOUNDS BY A SULFURO-NITRIC  
ACID MIXTURE AND OTHER ENERGETICALLY  
NITRATING MEANS. (O mekhanizme nitrovaniya  
aromaticeskikh soedinenii sernoazotnoi smes'yu i  
drugimi energichno nitruyushchimi sredstvami).  
A. I. Titov. 13p. (Trans. from Zhurnal Obshchei  
Khimii, v. 18, pt. 1, 1948, p. 733-740).

The nitration by nitric acid of benzene and other  
aromatics possessing a nuclear affinity equal to or  
less than that of benzene, occurs principally through  
an intermediate interaction with various forms of  
nitrogen dioxide only at low concentrations of the  
acid. The authors attempt to explain this phenome-  
non.

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